Buffalo Wallow Field Study

For: Oklahoma Geological Survey

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Overview

• Reservoir Overview
• Field Wide Study Results
• The Fracture Fluid System
• Core Tests & Results
• Case Studies
  – Lease Acreage #1 (15 Wells)
  – Lease Acreage #2 (16 Wells)
  – Lease Acreage #3 (14 Wells)
Granite Wash Reservoir

- Wash Types:
  - Morrowan (Historically, Primary Play)
    - Cherty
  - Atokan
    - Chert to Carbonate
  - Lower & Middle Cherokee
    - Typically Carbonate
  - Red Fork
    - Commonly carbonate w/ Granatic Materials (local)
Granite Wash Reservoir

- Highly Lenticular
- Variable Permeability
- Variable Porosity
- Variable Water Saturation
- Variable Rw

- Difficult OH environment for extensive log sweeps

- Porosity Thickness ($\phi H$) is not directly related to Permeability Thickness ($kH$)

Drilling Explosion
Wheeler, Hemphill & Roberts Counties
Statistical Analysis of Treatments

Production Trends vs. Fracture Variable
101 Wells
Buffalo Wallow Field

<table>
<thead>
<tr>
<th>Initial Production</th>
<th>Net Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Day Cum’s</td>
<td>Gross Pay</td>
</tr>
<tr>
<td>60 Day Cum’s</td>
<td>Fracture Rate</td>
</tr>
<tr>
<td>90 Day Cum’s</td>
<td>Fracture Volume</td>
</tr>
<tr>
<td>180 Day Cum’s</td>
<td>Proppant Type &amp; Mass</td>
</tr>
</tbody>
</table>

See SPE 104546 for more details

Buffalo Wallow Field Development
2006 - Present

Designed Sand bbls per Well, 101 Wells

Designed Water bbls per Well, 101 Wells
Buffalo Wallow Field Development
2006 - Present

![Graph showing Lbs/Net Pay per Well, 92 Wells]

![Graph showing Gallons/Net Pay per Well, 92 Wells]

A Water Frac is a Water Frac is a Water Frac RIGHT?

**Conventional Fluid Systems**

1. Conventional Friction Reducer
2. Conventional Surfactant
3. Clay Control (typically KCL)
4. Biocide

**Adaptive Fluid Systems**

1. Anionic Friction Reducer
2. Deflocculant / Viscosity Reducing Agent
3. Microemulsion Surfactant
4. Surface Modification Agent on Sand
5. Clay Control (typically KCL)
6. Biocide
Core Testing

- 23 Standard Sidewall Cores
- Previously Tested by 3rd Party for Initial Permeability

### Table 1—Regained Permeability Testing for Lower Permeability Granite Wash Side-Wall Core Samples

<table>
<thead>
<tr>
<th></th>
<th>No. of Tests</th>
<th>Regained Permeability, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>3</td>
<td>68</td>
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<tr>
<td>Surfactant comparison</td>
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<td></td>
</tr>
<tr>
<td>ME</td>
<td>8</td>
<td>82</td>
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<tr>
<td>CS</td>
<td>9</td>
<td>73</td>
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<tr>
<td>Deflocculant comparison*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With DE</td>
<td>6</td>
<td>87</td>
</tr>
<tr>
<td>Without DE</td>
<td>2</td>
<td>68</td>
</tr>
<tr>
<td>SMA comparison</td>
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<td></td>
</tr>
<tr>
<td>With SMA</td>
<td>7</td>
<td>67</td>
</tr>
<tr>
<td>Without SMA</td>
<td>10</td>
<td>84</td>
</tr>
</tbody>
</table>

*Tests only performed with new anionic friction reducer.
Case Study

- 3 Lease Ranch Areas within the Buffalo Wallow Field
- Lease Acreage #1 (15 Wells)
- Lease Acreage #2 (16 Wells)
- Lease Acreage #3 (11 Wells)

- All wells have 4 fracture treatments
- All treatments targeted 80 bpm, only wells with a standard variation less than 2% are included in this study.

Lease Acreage #1

![Average Production Decline](chart.png)
Lease Acreage #1

Lease Acreage #2
Lease Acreage #2

Lease Acreage #3
Results and Conclusions

• Maintain Consistency with Fracturing Variables in order to make informed decisions
• Sub fields within the Buffalo Wallow have dramatically varying production mechanisms and rates

• Increased volume of sand per foot of net pay indicates slight production benefit
• Increased volume of fluid per foot of net pay indicates slight production benefit
• Increased # of perforations indicate slight production benefit
Thank You

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